

# ILA 201-U Model Solutions

## November 2025

### 1. Learning Objectives:

2. The candidate will understand how to explain and apply the methods, approaches and tools of financial capital management for life insurance company under a US regulatory framework.
3. The candidate will understand types of life insurance risks, the impacts of diversification, crediting rating agency frameworks, and the assessment of risk management.

### Learning Outcomes:

- (2a) Explain and calculate required capital under a US regulatory framework.
- (2c) Explain and evaluate the respective perspectives of regulators, investors, policyholders and insurance company management regarding the role and determination of capital.
- (2d) Explain and apply methods in capital management.
- (3a) Analyze the impact of risk diversification, including considerations for modeling and offsets between mortality and longevity risk.
- (3b) Understand the role and framework used by credit rating agencies for evaluating life insurance companies.

### Sources:

Ch. 29: Risk-Based Capital: Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

Rating Agency Perspectives on Insurance Company Capital, SOA Research Institute, Aug 2023 (excluding Appendices)

### Commentary on Question:

*Purpose of question was to evaluate ability of candidates to understand implications of business decisions on regulatory/rating agency capital and to demonstrate knowledge of capital calculation approaches.*

# 1. Continued

## **Solution:**

(a) Critique the following statements:

- (i) *Entering into the offshore reinsurance transaction for the variable annuity business will lower XYZ's total adjusted capital (TAC). The off-balance sheet items are not applied to the Company Action Level amount.*
- (ii) *XYZ uses book value of bonds for both risk-based capital (RBC) and rating agency capital. If there is a decrease in interest rates, then there will not be an impact to the available capital on either the RBC or rating agency capital framework.*
- (iii) *The Company Action Level amount for ULSG business will be lower because the face amount used in the C-2 calculation is lower as a result of the YRT reinsurance.*

## **Commentary on Question:**

*Maximum points were allocated to candidates who identified the validity of each the two statements in each section and provided supporting information to explain logic behind response.*

*Most candidates only received partial credit for this question. Answers generally did not recognize how reinsurance risk impacts TAC and CAL or could not correctly state how bonds are valued by RBC and rating agency capital.*

- (i) This is partially correct. TAC impact will depend on supporting information related to reinsurance agreement. The coinsurance agreement will decrease the C-3 risk, but it will increase the C-1 risk. Off-balance sheet items, such as the payments XYZ guarantees for its subsidiary, get applied to RBC. They are captured in the Asset Risk – Other (C-1).
- (ii) This is partially correct. RBC applies to the book value, but rating agencies use market value to determine capital amounts. RBC won't recognize unrealized gains and losses, but rating agencies apply an adjustment for these. The drop in interest rates will have a negative effect on capital for the rating agency framework.
- (iii) This is partially correct. Insurance risk (C-2) does get lowered due to a YRT deal, but the factor gets applied to the NAR (net amount at risk) which is the face amount minus reserve minus ceded face. While C-2 (insurance risk) gets lowered due to YRT, C-1 gets increased due to the risk of the reinsurer going insolvent.

# 1. Continued

- (b) Calculate the BCAR assessment based off the following:

AM Best BCAR Capital	Amount
Available Capital	2000
Net Required Capital @ 95% Confidence Level	1000
Net Required Capital @ 99% Confidence Level	1750
Net Required Capital @ 99.5% Confidence Level	1800
Net Required Capital @ 99.6% Confidence Level	1950
Net Required Capital @ 99.8% Confidence Level	1990

## Commentary on Question:

*Maximum points were allocated to candidates who correctly calculated BCAR at multiple confidence levels and provided supporting information as to strength based on results.*

*Most candidates were able to articulate the BCAR formula. Common partial responses include:*

- Only calculating one BCAR score
- Incorrect formula

$$BCAR = \frac{(Available\ Capital - Net\ Required\ Capital)}{Available\ Capital} \times 100$$

Net Required Capital @ 95%	50
Net Required Capital @ 99%	12.5
Net Required Capital @ 99.5%	10
(Strong rating if > 0 and < 10 @ 99.6% ci)	
Net Required Capital @ 99.6%	2.5
Net Required Capital @ 99.8%	0.5

- (c) Describe how each capital model utilizes diversification among the risks.
- (i) Fitch
  - (ii) US RBC

## 1. Continued

### **Commentary on Question:**

*Maximum points were allocated to candidates who identified specifics around diversification for Fitch and RBC capital measures and shared supporting detail.*

*More candidates were able to articulate RBC formula and diversification approach with support. It was less common for candidates to get full credit for Fitch approach.*

- (i) Fitch uses predefined and product-specific correlation matrices for each stress level. This reflects that product charges will perform differently under various scenarios. Since XYZ offers both UL and VA products there would be a recognition in the correlation matrix that Fitch uses to reduce the risks.
- (ii) US RBC has a covariance adjustment that recognizes correlation between certain risk categories. It assumes that asset-risk all other and interest rate risk are correlated with each other and asset risk – unaffiliated common stock and affiliated non-insurance stock are correlated with each other. All of the other risks are independent. There will be a correlation between the equity and VA risk. The ULSG will also have a correlation between fixed assets.

## 2. Learning Objectives:

1. The candidate will understand and apply U.S. valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (1a) Describe, apply and evaluate the appropriate valuation methods, requirements, and techniques and related under the US statutory framework, including the calculation of principles-based reserves and formulaic reserves.
- (1b) Describe, apply and evaluate the appropriate valuation methods, requirements, and techniques and related under the US GAAP framework, including the calculation of reserves and related items (e.g., DAC).

### Sources:

Statutory Valuation of Individual Life and Annuity Contracts, Chapter 24

### Commentary on Question:

*Goal of this question was to test candidate's knowledge and understanding of VM-21, particularly the application of stochastic testing and the effect of VM-21 on the Income Statement. The written and spreadsheet portions of the question evaluated candidates' mastery of different but important concepts of VM-21 as they pertain to the derivation and calculation of the Stochastic Reserve.*

### Solution:

- (a) Critique the following statements with respect to VM-21:
  - (i) *The VM-21 stochastic reserve is calculated based on the results derived from an analysis of asset and liability cashflows produced by the application of a stochastic cashflow model. Equity returns and interest rate scenarios are generated stochastically while other assumptions reflect company specific best estimates. The goal of the stochastic reserve is to quantify the amount of statutory reserves needed to meet contractual obligations at the 50<sup>th</sup> percentile.*
  - (ii) *VM-21 allows for the costs and benefits of a clearly defined hedging strategy to be accounted for in the cashflow projections. These costs and benefits of a clearly defined hedging strategy are included in all components of the stochastic reserve.*

## 2. Continued

### **Commentary on Question:**

*Candidates generally did very well with subsection (a). Generally they understood that scenario testing is used to measure reserves under a wide variety of economic scenarios and that reserves are set to cover the CTE70 of those scenarios, however some candidates expressed this as the 70% best scenarios instead of CTE70. Most were able to explain that other assumptions are based on prudent assumptions, although most used the term Best Estimate + Margin. Some either did not state the parts of the statements that were true or failed to explain why other parts were false. (ii) Candidates were particularly prepared to address how a Clearly Defined Hedging Strategy can be appropriately reflected in the stochastic reserves.*

### **Solution:**

*A sample full point answer to a(i) is as follows:*

*The first statement is correct. VM-21 Stochastic Reserve is based on results of asset and liability cashflows derived from a stochastic model.*

*The second statement is partially correct. While equity returns and Interest Rate scenarios are generated stochastically, other assumptions are best estimate PLUS a margin for adverse deviation.*

*The final statement is also incorrect, the goal is to quantify the amount of STAT reserves needed at the CTE70 not the 50<sup>th</sup> percentile.*

*A sample full point answer to a(ii) is as follows:*

*It is true that VM-21 allows for the cost and benefits of a Clearly Defined Hedging Strategy in cash flow projections.*

*Since we still need to account for the cashflows ignoring hedging, it is inaccurate to say the strategy is included in “All” components.*

*The final VM-21 reserve equals:  $CTE70(BE) + E \times \max(0, CTE70(Adj) - CTE70(BE))$  where E is between 5 and 100%.*

*The BE component takes into account the hedging strategy whereas the “Adj” component does not. E is an error factor that ranges from 5% to 100% based on the quality of the hedging.*

## 2. Continued

(b) Calculate the following items over the 12-year projection:

- (i) Pre-tax profits
- (ii) General account assets
- (iii) Separate account assets

**Commentary on Question:**

*Candidates were well prepared for (i), but found (ii) and (iii) more challenging. A large percentage of the errors on (ii) and (iii) were related to excluding General Account in calculating (ii) or Separate Account in (iii). Another common error was including interest (ii) or excluding the S&P return and/or transfers to the Separate Account in (iii).*

*Example of full point answer is in Excel.*

(c) Calculate the following VM-21 values over the 12-year projection:

- (i) PV of accumulated deficiencies
- (ii) Scenario reserve (as of valuation date only)

**Commentary on Question:**

*c(i) was the most difficult subsection for the candidates. Common errors were excluding either the General Account or Separate Account or both in the accumulated deficiencies. It was also common to use a rate other than the NAER to discount. A commonly used incorrect discount rate was using  $1.05 \times$  Treasury Rate to discount rather than the NAER.*

*c(ii) was generally a little easier for the candidates, although leaving out the General Account or Separate Account or both was still common.*

*Example of full point answer is in Excel.*

### 3. Learning Objectives:

1. The candidate will understand and apply U.S. valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

#### Learning Outcomes:

- (1a) Describe, apply and evaluate the appropriate valuation methods, requirements, and techniques and related under the US statutory framework, including the calculation of principles-based reserves and formulaic reserves.

#### Sources:

Chapter 11: Valuation Methodologies, Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

Chapter 12: Whole Life, Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

Chapter 23: VM-20: PBR for Life Products, Statutory Valuation of Individual Life and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5th Edition, 2018

#### Commentary on Question:

*This question tested the candidates' knowledge on statutory valuation for a nonparticipating and a participating whole life policy.*

#### Solution:

- (a) You are given the following information for a 10-pay whole life policy:
  - Issue age is 43.
  - Level annual premiums, paid at the beginning of each policy year for ten years.
  - Death benefit is 100,000 and paid at the end of the policy year.
  - Statutory valuation rate is 3.5%.

t	Attained Age	$1000q_{(43)+t}$	$1000A_{(43)+t}$	$\ddot{a}_{(43)+t}$	$\ddot{a}_{(43)+t:[20-t]}$	$\ddot{a}_{(43)+t:[10-t]}$
0	43	1.04	244.0167	22.3555	14.5251	8.5667
1	44	1.05	251.7792	22.1260	14.0131	7.8397
2	45	1.07	259.8143	21.8883	13.4827	7.0865
3	46	1.11	268.1246	21.6426	12.9334	6.3063
4	47	1.17	276.7062	21.3888	12.3648	5.4981

Calculate the CRVM basic reserve at the end of policy year 3. Show all work.



### 3. Continued

**Commentary on Question:**

*Most candidates performed well on this question. Full credits were given if the following were performed: calculating the correct expense allowances, determining that the expense allowance is the smaller of that over the plan of the insurance and that over a 20-pay contract, calculating the correct net premiums, using the correct annuity factors, and using the correct CRVM formula.*

See Excel file

- (b) Given the following information for a level pay whole life policy where the next policy anniversary is 6 months after the valuation date:

- Premiums are paid annually at the beginning of the policy year.
- Mid-terminal CRVM reserves are held.
- Annual Gross Premium = 600
- Annual Net Premium = 500

Calculate the following. Show all work.

- (i) Deferred premium asset
- (ii) Unearned net premium liability

**Commentary on Question:**

*In addition to calculating the correct DPA and UPL, an explanation is required to receive full credits. Partial credits were given when candidates provided the correct numerical answer without any explanations.*

See Excel file

- (c) Critique the following statements related to a new participating whole life product.

- (i) *Dividends do not need to be considered when calculating the reserves.*
- (ii) *The reduced paid-up insurance amount at time  $t$  is the amount of insurance that can be purchased with the cash surrender value using maximum nonforfeiture interest rate and mortality table in effect at time  $t$ .*
- (iii) *Under VM-20, deterministic reserve is required, but stochastic reserve does not need to be calculated if the stochastic exclusion ratio test is passed.*

### 3. Continued

- (iv) *For the VM-20 stochastic exclusion ratio test, the deterministic reserve is calculated for each of the 16 prescribed scenarios, using the same assumptions as for the deterministic reserve except that the following are scenario specific: interest rates, equity return assumptions, and net asset earned rates used to discount cash flows.*

#### **Commentary on Question:**

*Candidates performed well for part iii and iv, but not for part i and ii. Candidates should respond to statements that they are asked to critique in either of two ways: (1) "The statement is true", or (2) "The statement is false because . . ." and then the candidate would respond as to what part of the statement needs to be corrected in order for the statement to become correct.*

*For subpart i, candidates commonly answered in STAT, GAAP, or both. Given the ambiguity of the sub-question, full credits were given for when the candidate correctly answered in either STAT or GAAP, and both pre-PBR & VM-20 for STAT or pre-LDTI & LDTI for GAAP.*

*For subpart ii, partial credits were given if the candidate was able to demonstrate understanding of the RPU, despite not correcting that the statement should be at issue.*

*For subpart iii, full credits were given if the candidate is able to demonstrate knowledge of both the SERT and DET.*

*For subpart iv, partial credits were given if the candidate is able demonstrate knowledge of the SERT, despite not correcting that the adjusted deterministic reserve assumptions are calculated using anticipated experience assumptions without margins*

- i. This statement is false because VM-20 requires that dividends do not need to be considered when calculating formulaic reserves but do need to be considered when modelling the product for either exclusion testing or modelled reserves.
- ii. This statement is false because the use of maximum interest rate and mortality table assumptions should be as of the issue date rather than at time t.
- iii. This statement is false because the deterministic reserve is not required for Whole Life provided it can pass deterministic exclusion testing. Stochastic reserves are required when the stochastic exclusion ratio test fails. If the stochastic exclusion ratio test fails, then the deterministic exclusion testing automatically fails as well, and then, deterministic reserves are required.
- iv. This statement is false because the stochastic exclusion ratio test uses adjusted deterministic reserve calculated using anticipated experience assumptions with no margins.

#### **4. Learning Objectives:**

2. The candidate will understand how to explain and apply the methods, approaches and tools of financial capital management for life insurance company under a US regulatory framework.
3. The candidate will understand types of life insurance risks, the impacts of diversification, crediting rating agency frameworks, and the assessment of risk management.

#### **Learning Outcomes:**

- (2d) Explain and apply methods in capital management.
- (3c) Explain and understand the use and application of the Own Risk Solvency Assessment (ORSA) report.

#### **Sources:**

Ch. 29: Risk-Based Capital – Statutory Valuation of Individual Life Insurance and Annuity Contracts, Claire, D., Lombardi, L. and Summers, S., 5<sup>th</sup> Edition, 2018

ILA201-802-25: NAIC Own Risk and Solvency Assessment (ORSA) Guidance Manual, National Association of Insurance Commissioners, Dec 2017

#### **Commentary on Question:**

*The goal of the question is to test the candidate's knowledge of the Own Risk and Solvency Assessment (ORSA) report and Risk-Based Capital (RBC). On average, candidates performed well on this question.*

#### **Solution:**

- (a) Describe the purpose of risk-based capital for the life insurance industry.

#### **Commentary on Question:**

*There were many acceptable answers to this part, and most candidates received either partial or full credit. Below is an example of a detailed answer that would receive full credit.*

Risk-Based Capital assesses the financial solvency level of the life insurance company to support its overall business operations based on its size and risk profile. The primary purpose of RBC is to minimize the risk and cost of insolvency when it occurs. RBC determines the minimum amount of capital a life insurance company must hold to not trigger regulatory action, and it is intended to capture adverse scenarios at the 90% to 95% confidence level, which is above the minimum statutory reserve, results of cash flow testing, and the asset valuation reserve.

## 4. Continued

- (b) Recommend one of the following provided portfolios for ZJL Life. Justify your response.

			Asset Allocation		
Type of asset	RBC factor	Expected annual return	Current Portfolio	Portfolio A	Portfolio B
Class 1 Bonds	0.004	3%	10%	5%	5%
Class 3 Bonds	0.046	4%	20%	10%	10%
Class 5 Bonds	0.230	5%	10%	5%	5%
Residential Mortgage	0.001	5%	5%	5%	5%
Class 1 Common Stock	0.004	5%	15%	20%	10%
Class 3 Common Stock	0.046	7%	20%	30%	30%
Class 5 Common Stock	0.230	10%	20%	25%	35%

### Commentary on Question:

*Overall, most candidates performed well on this part. The most common approach was to calculate the average RBC Factor and average expected return for the three portfolios using a simple average. Candidates should have recognized that the goal of ZJL Life was to maintain their current RBC ratio and recommend Portfolio A by noting that Portfolio A had a higher expected return than the current portfolio while maintaining the same average RBC factor.*

*Some candidates recognized that the Authorized Control Level Risk-Based Capital includes a covariance adjustment to account for the correlation between certain risk categories. This question does not provide the capital requirements for the other risk categories that would impact the RBC requirements for each portfolio. Credit was given to candidates who made a correctly justified portfolio recommendation given the limited information provided in the question.*

## 4. Continued

	Avg. expected return	Average RBC Factor
Current Portfolio	6.00%	0.08845
Portfolio A	6.65%	0.08845
Portfolio B	7.15%	0.11105

Portfolio A is the recommendation. This is justified because Portfolio A has a higher return than the current portfolio, and because the average RBC factor is equal to the current portfolio, so we would expect the RBC ratio to be maintained at its current 300% level, whereas Portfolio B would cause the RBC ratio to be adversely affected which is against ZJL Life's stated objective.

OR

To account for covariance, the Authorized Control Level Risk-Based Capital is calculated as:

$$0.5x [C0+C4a+ \text{sqrt} [(C1o+C3a)^2+(C1cs+C3c)^2+C2^2+C3b^2+C4b^2]]$$

Given the limited information provided, assume that the bonds and residential mortgages are categorized as C1o, and the common stocks are categorized as C1cs. Assume all other risk categories are 0. Based on this calculation, the company should maintain its current portfolio to maintain the current RBC levels. However, it's unlikely that the C3a (Interest Rate Risk) and C3c (Market Risk) are 0. Depending on the levels of those risks, the RBC level could be maintained by selecting either A or B. With further testing, if the company determines that they can maintain their current RBC level with Portfolio A, that would be recommended over the current portfolio due to its higher expected return.

- (c) Critique the following statements
- A. *ZJL Life is exempt from performing any cash flow testing for C-3 RBC because the C-3 significance test ratio is less than 40%.*
  - B. *ZJL Life's Additional Asset Requirement should be calculated using a deterministic best estimate scenario of the underlying equity returns.*
  - C. *Due to the confidentiality of ORSA reporting, ORSA is only required to be filed with the regulator when an insurer's RBC ratio falls below the regulatory threshold.*

### Commentary on Question:

*Most candidates received full credit for Statement A. For Statement B, some candidates got confused between stochastic prescribed underlying equity returns and prudent best estimate assumptions that are used for non-stochastic assumptions, such as mortality or lapse. For Statement C, most candidates received partial or full credit. While the answer to Statement C below lists out all company action levels, this entire list was not required to receive full credit.*

## 4. Continued

STATEMENT A: This statement is not correct. For a company to be exempt from RBC C3 testing, they must also pass the stress test. This determination is done by calculating the ratio of (A) divided by (B), where: (A) is Total Adjusted Capital; and (B) is Risk-Based Capital after covariance with RBC interest rate risk requirement for annuity multiplied by 7.5. If this ratio is greater than 100%, then the second condition is satisfied.

OR

This statement is not correct. ZJL has only VA business, so the company is subject to C3 Phase II. The C-3 significance test is only applicable to C3 Phase I.

STATEMENT B: This statement is not correct. To perform the required capital calculation, for Variable Annuity products, a stochastic scenario simulation using prescribed underlying equity returns should be used. Prudent best estimate assumptions are applicable for non-stochastic variables such as mortality and lapse.

STATEMENT C: This statement is not correct. An insurer is only exempt from filing an ORSA summary report if the individual insurer writes less than \$500M in annual premium and if the insurance group collectively writes less than \$1B in direct/assumed premium. The RBC ratio determines whether regulators will take action. An RBC ratio between 200% and 300% requires the life insurance company to perform a trend test. Between 150% and 200% they must prepare and submit an RBC plan to the commissioner. Between 100% and 150% the company must submit an RBC plan, or if applicable, a revised RBC plan to the commissioner. Between 70% and 100% the commissioner is authorized to take whatever regulatory actions are considered necessary to protect the best interests of the policyholders and creditors. An RBC ratio below 70% requires the commissioner to take actions necessary to place the company under regulatory control.

- (d) Compare key components of the ORSA report and risk-based capital.

### **Commentary on Question:**

*Full credit was given to candidates who provided a detailed response by including, but not limited to, several of the components below comparing the ORSA report and risk-based capital.*

RBC ratio is calculated as a ratio using a closed-form formula taking C1 (asset risk), C2 (insurance risk), C3 (interest rate risk), and C4 (business risk) into consideration with a covariance adjustment, depending on the resulting ratio, it could trigger regulatory action with NAIC; ORSA report first defines the insurer's risk management framework, and then assesses the underlying risk exposure, and then provides a group assessment of risk capital and prospective solvency assessment.

## 4. Continued

Other comparisons between ORSA and RBC include:

- RBC is more of a quantitative measure with a prescribed formula whereas ORSA is more qualitative and subjective.
- ORSA is a confidential internal document whereas RBC provides a standardized regulatory view of a company's ability to satisfy their obligations to policyholders.
- Both ORSA and RBC exist to promote sufficient capital adequacy to support the risks associated with the insurer.
- Target audience for RBC is the NAIC/Regulators and for ORSA it can be regulators but is also for company management to be sure the company has a risk management plan in place.

## 5. Learning Objectives:

1. The candidate will understand and apply U.S. valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

### Learning Outcomes:

- (1b) Describe, apply and evaluate the appropriate valuation methods, requirements, and techniques and related under the US GAAP framework, including the calculation of reserves and related items (e.g., DAC).

### Sources:

Chapter 11: Deferred Annuities US GAAP for Insurers, Freedman, M., and Frasca, R., 3rd Edition, 2024

### Commentary on Question:

*This question evaluates the candidate's ability to apply U.S. valuation principles and financial management concepts to a variable annuity contract with a GMDB rider under realistic assumptions.*

*Part (a) and (b) test the candidate's ability to calculate Market Risk Benefit (MRB) liabilities at issue and after a market change, demonstrating understanding of principles-based and formulaic reserve calculations under U.S. statutory and GAAP frameworks.*

*Parts (c) and (d) assess conceptual understanding of how changes in key parameters (GMDB roll-up rate and OCA) affect fee attribution, MRB liability, and net income. This demonstrates the candidate's ability to link product features and financial metrics to risk and profitability.*

### Solution:

- (a) You are given the projections at issue for 3 scenarios in Excel.

Calculate the Market Risk Benefit (MRB) liability at issue. Show all work.

### Commentary on Question:

*Candidates generally performed well in this question. Most candidates calculated the GMDB exposure and survival rate correctly. However, some candidates didn't decrement the excess benefits or fees. A few candidates didn't use the correct discount rate.*

*A common mistake is failing to discount fees and excess benefits at the correct timing when calculating present values.*

*Most candidates used the correct formula to calculate the attributed fee ratio and MRB liability.*



## 5. Continued

*Some candidates failed to correctly determine the GMDB exposure by deducting the GMDB rollup from the account value.*

*Some candidates failed to correctly calculate the Death Benefit at time  $[T]$  as the Exposure at time  $[T]$  \* Survivorship at time  $[T-1]$  \*  $Q_x$  at time  $T$ .*

*Errors include but not limited: (1) Forgot applying the Survivorship at time  $[T-1]$ ; (2) Directly used the GMDB exposure without applying both Survivorship at time  $[T-1]$  and Mortality Rate  $Q_x$  at time  $[T]$ .*

*Credits are given if candidates assume fees are paid either at the beginning of the year or at the end of the year, using the appropriate formulas based on lives in force and discounted accordingly.*

See Excel file

- (b) You are given an updated projection reflecting the actual 10% market growth during year 1 in Excel.

Calculate the MRB liability at the end of Year 1. Show all work.

### **Commentary on Question:**

*Some candidates failed to realize that Part (b) assumes the policyholder survived the first policy year, so  $q_x$  should apply only from policy year 2 onward. Part (b) should also include nine excess benefits and fees.*

*Additionally, a few candidates recalculated the attributed ratio instead of using the same ratio from Part (a).*

*Regarding timing of the fees, in order to receive full credits, part B must be consistent with part A by assuming the fees are paid either at the beginning of the year or at the end of the year.*

See Excel file

- (c) Analyze qualitatively the impact on the attributed fee ratio if the GMDB roll-up rate were 6% instead of 5%.

### **Commentary on Question:**

*Most candidates answered this question well, correctly noting the GMDB risk exposures would increase and the attribution fee ratio would increase.*

## 5. Continued

If the roll up rate was 6% instead of 5%, this would increase the amount of excess benefits paid out. This would not impact the account value but would increase the death benefit. Excess benefits = death benefit – account value.  $AF\% = \text{Avg PV}(\text{Excess benefits}) / \text{Avg PV}(\text{explicit fees})$  capped at 100%. Avg PV of explicit fees will be unchanged since fees are assessed as a percent of fund value which is unchanged. The numerator Avg PV(Excess benefits) will increase. With a higher numerator and a constant denominator the attributed fee ratio will be higher.

- (d) Analyze the following qualitatively if the OCA were to increase:
- (i) The impact on MRB liability
  - (ii) The impact on net income

### Commentary on Question:

- (i) *Most candidates noted that the discount rate would increase; however, some did not elaborate on how this changes the present value of excess benefits and fees, and its impact on the MRB liability.*
- (ii) *Candidates generally did not perform well on this question. Many failed to note that OCA is reflected in Other Comprehensive Income (OCI) and does not affect net income. Candidates who identified that OCA is reflected in OCI but drew the wrong conclusion about its impact on net income received partial credit. Candidates who provided self-contradictory answers in (i) and (ii) did not receive credits.*

- (i) Own credit adjustment works to increase the discount rate.

Since OCA impact the discount rate used to discount the liability cashflows, it will affect the PV calculated in the liability. In general, PV would decrease when the discount rate increase. The MRB liability is calculated as  $\text{PV of excess benefit} - AF\% * \text{PV explicit fee}$ . When OCA increases, both PV of excess benefit and PV explicit fee would decrease. If the decrease in PV of excess benefit is larger than the decrease in PV of explicit fee, the total MRB liability would decrease.

- (ii)  $\text{AOCI}(t) = \text{MRB at original discount rate} - \text{MRB at current discount rate}$ .  
 $\text{OCI}(t) = \text{AOCI}(t) - \text{AOCI}(t-1)$ . If OCA were to increase, the MRB liability will decrease. AOCI and OCI will be positive. It's a positive income, recognized as OCI, not net income. The net income remains the same.

## 6. Learning Objectives:

4. The candidate will understand the fundamentals of value creation and inforce management techniques for life and annuity products.

### Learning Outcomes:

- (4d) Describe and apply the methods and principles of embedded value for an insurance enterprise.

### Sources:

Embedded Value: Practice and Theory, Actuarial Practice Forum, Mar 2009

### Commentary on Question:

*Commentary listed underneath question component.*

### Solution:

- (a) Calculate the risk discount rate (RDR). Show all work.

#### Commentary on Question:

*Most candidates elected to calculate the Risk Discount Rate under the Weighted Average Cost of Capital (WACC) recognizing the equity and debt structure. Full credit was awarded to candidates who used CAPM (Capital Asset Pricing Model) exclusively. Candidates did not receive full credit if they did not adjust equity returns using the beta correlating company returns to the S&P 500 return. Candidates were not penalized for using a pre-tax or post-tax basis as this was not specified as long candidates applied tax consistently to equity and debt returns under WACC.*

See Excel file

- (b) Calculate the following metrics, using the RDR from part (a).
  - (i) Present Value of post-tax Statutory Book Profits
  - (ii) Value of Cost of Capital
  - (iii) Inforce Business Value

## 6. Continued

### Commentary on Question:

- (i) *Most candidates were able to identify the source of book profit being the change in surplus minus surplus accumulated at a post-tax interest rate. Candidates who did not accumulate surplus at post-tax rate lost some credit. Many candidates accumulated interest only on the required capital portion of surplus and lost some credit. Candidates who did not discount at the risk discount rate from part a were not awarded full credit. Candidates generally did well on this item.*
- (ii) *Candidates did well in identifying the required capital as the key input to consider when calculating the value of cost of capital. Candidates who used a WACC including debt in part a were awarded full credit as the RDR implicitly recognized debt in the calculated rate. Candidates who did not use WACC were awarded full credit if their accumulation rate was adjusted for debt either implicitly or explicitly. The model solution demonstrates both approaches. Candidates who did not take the present value of cost of capital were not awarded full credit. Some candidates discounted at the risk-free rate instead of the RDR and were not awarded full credit.*
- (iii) *Most candidates understood the definition of inforce book value and applied it correctly. Candidates were awarded full credit if their answer reflected the corrected definition of Inforce Business Value (IBV) = PVBP - PVCoC regardless of the correct use of the calculation of either PVBP (6b.i) or PVCoC (6b.ii).*

See Excel file

- (c) Assume the current book value of assets equals the realizable market value.

Calculate the Embedded Value at time 0. Show all work.

### Commentary on Question:

*Candidates struggled in this question to correctly identify the definition of Embedded Value (EV) with many defining EV as the sum of PVDE (present value of distributable earnings) + FS (free surplus). For candidates who correctly identified EV as the sum of IBV + ANW (Adjusted Net Worth), with  $ANW = FS + RC$  (Required Capital), candidates lost credit for incorrectly identifying FS as 1000 instead of understanding the Surplus total given includes both FS and RC, that is  $Surplus = RC + FS$  or equivalently  $FS = Surplus - RC$ . Candidates who included value of new business were not awarded full credit.*

See Excel file